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NUEXCO

NOVEMBER 1983 NUMBER 183

Monthly Report on the Nuclear Fuel Market

NUEXCO

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EXECUTIVE SUMMARY
REPORT 183
(All data as of October 31, 1983)

Exchange Value $23.50, down $0.50

The **Exchange Value** is **$23.50** per pound U_3O_8, down $0.50 since last month, the first decline in fourteen months. Three uranium sales transactions are reported, involving approximately 275 thousand pounds U_3O_8 *equivalent*. Two transactions involved enriched UF_6 and one involved concentrates.

Supply-Demand Ratio rose slightly to 1.9:1

Active spot and near-term **uranium supply** amounts to **5.9** million pounds U_3O_8 *equivalent*, down 1.3 million pounds from last month. **Active** spot and near-term **uranium demand** fell 1.3 million pounds, to **3.1** million pounds U_3O_8 equivalent. Therefore, the spot and near-term **supply-demand ratio** rose slightly to **1.9:1**.

Transaction Value unchanged at $23.65

The **Transaction Value** is **$23.65** per pound U_3O_8. It includes 21 transactions involving a total of 2.0 million pounds equivalent U_3O_8 and covers a period of six months.

Loan Use Charge Rate unchanged at 6%

The **Loan Use Charge Rate** is **6 percent** per annum. No loans are reported.

Conversion Value decreased to $0.60

The **Conversion Value** is **$0.60** per pound U as UF_6, down $0.40 since last month. One secondary market conversion transaction is reported, involving 101-300 thousand pounds U as UF_6.

SWU Values $115 for DOE origin (FY84); $85 for non-DOE origin (delivery within 15 months)

The SWU Values are **$115 per SWU of DOE origin** and **$85 per SWU of non-DOE origin.** The two SWU Values reflect the development of a two-tiered market as a result of DOE's modification of its Interim Sales Contract (ISC) offer. However, the market is still in a state of flux; this month's SWU Values were based on sellers' offers in the absence of transactions under the current altered market conditions. Spot and near-term demand for secondary market enrichment services amounts to 600 thousand SWUs; spot and near-term supply amounts to 1.1 million SWUs. This issue reports four secondary market SWU sales, involving a total of approximately 400 thousand SWUs.

Enrichment

This issue analyzes the commercial impact of DOE's modified ISC offer to holders of 3.5-year Requirements contracts.

Australia

The Prime Minister and his Cabinet are proposing a compromise policy for uranium mining and export, and environmentalists have won a preliminary victory that further threatens the Jabiluka project.

Japan

A recent government analysis of costs for alternate electricity sources shows that nuclear power has clear long-term advantages and will retain them as long as capital costs are controlled. Tohuku Electric Power's Onagawa Unit 1 has reached criticality thirteen years after a construction permit was granted.

South Africa

South Africa continues to be a reliable source of uranium, producing 3.9 million pounds U_3O_8 in the third quarter of 1983, almost exactly as much as in the second quarter of this year.

United States

Nuexco has revised upwards its forecast of US uranium production for 1983, but still anticipates 1984 to be a year of dwindling capacity.

Essay

Since the inception of the nuclear fuel market, the focus of its activity has shifted from the primary markets to the secondary markets for uranium concentrates and fuel cycle services. The natural course of events would lead to a return to emphasis on the primary markets if the secondary markets were allowed to function unimpeded.

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NUEXCO REPORT 183 FIGURES OF THE MONTH (October 31, 1983)	This Month (Report 183)	Last Month (Report 182)	12 Months Ago (Report 171)
Exchange Value[1]	23.50	24.00	17.50
Transaction Value[1]	23.65	23.65	17.00
Conversion Value[2]	0.60	1.00	1.60
Loan Use Charge Rate[3]	6%	6%	6%
Near-Term Uranium Supply[4]	5.9	7.2	4.3
Near-Term Uranium Demand[5]	3.1	4.4	2.1
Near-Term Supply-Demand Ratio	1.9	1.7	2.1
Recent Uranium Sales:			
Number of Transactions[6]	3	2	9
Quantity of Material[7]	0.1-0.3	0.1-0.35	1.4-3.0
Nuexco SWU Values:[8]			
DOE origin, FY 84 delivery	115	see note 11	—
non-DOE origin, delivery within 15 months	85		
USDOE SWU Prices:			
AFC	138.65	138.65	138.65
Requirements	149.85	149.85	149.85
Market Value of Enriched UF_6[9] [10]:			
2.5 w/o U_{235}	653.63	582.75	668.30
3.0 w/o U_{235}	838.93	743.24	865.68
3.5 w/o U_{235}	1,027.67	906.32	1,067.20
4.0 w/o U_{235}	1,218.95	1,071.62	1,271.79

[1]US $ per pound U_3O_8 equivalent.
[2]US $ per pound U as UF_6.
[3]Per annum.
[4]Active inquiries to sell, for delivery within 12 months after contract signing (millions of pounds U_3O_8).
[5]Active inquiries to purchase, for delivery within 12 months after contract signing (millions of pounds U_3O_8).
[6]Uranium sales only; does not include loans, conversion, or SWU transactions.
[7]Millions of pounds U_3O_8, equivalent.
[8]US $ per SWU.
[9]Calculated using the Nuexco Exchange Value, Conversion Value, and 0.20 percent tails assay. Calculations before 2/28/83 used the USDOE price for AFC SWUs. From 2/28/83 through 9/30/83, calculations used the Nuexco SWU Value for the relevant fiscal year. As of 10/31/83, calculations use the SWU value for DOE origin and FY 84 delivery.
[10]US $ per KgU as UF_6.
[11]SWU Values for 10/31/83 were the first to distinguish between origins, so prior SWU Values are not comparable.

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THE FUELISH CYCLE:
MARKETS FOR EXCESS FRONT-END MATERIALS

By

George White, Jr.
President
Nuexco

Presented To:

Atomic Industrial Forum
Uranium Seminar

Santa Fe, New Mexico
October 6, 1983

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THE FUELISH CYCLE: MARKETS FOR EXCESS FRONT-END MATERIALS

By: George White, Jr.
President
Nuexco

Introduction

The title of this paper is not meant to be flippant. I will be discussing the markets for excess materials and services in the front end of the nuclear fuel cycle. These markets, namely uranium and its related services, conversion and enrichment, have been driven by near-term perceptions which have not always been accurate, and, in fact, have often been dead wrong.

My comments today may appear unduly bearish. My position is somewhat contrary to the optimism that seems to be spreading. That is because I believe it is healthy to sound a cautionary note at a time when optimism is the order of the day. I'm cautiously optimistic about the long term. I'm just plain cautious about the near term.

I want to cover four areas today. Where are we now? How did we get there? Where are we headed? And, finally, the particular role of the spot and secondary markets.

Where Are We Now?

Things are not as bad as they were a year ago, but the front end markets remain under considerable strain. Excess capacity exists in all segments. Economics aside, the World Outside Centrally Planned Economic Areas (WOCA) currently has the annual capability:

1. to produce more than 140 million pounds U_3O_8;
2. to convert more than 140 million pounds U_3O_8 into 54.5 million kgs U in UF_6;
3. to enrich, using nearly 40 million SWUs, more than 160 million pounds U_3O_8 into 3.0 percent enriched product, assuming a 0.25 percent tails assay.

By way of comparison, Nuexco's forecast of 1983 WOCA uranium consumption is 80 million pounds U_3O_8. And our consumption forecast for 1995 is only 130 million pounds. To be sure, some existing uranium mines will be exhausted before 1995, but many would-be producers are waiting in the wings.

Not only is there excess capacity, actual production also exceeds consumption. This statement is true with respect to uranium for every single year since the dawn of the nuclear age. In 1982, WOCA uranium production was 107 million pounds U_3O_8; consumption was only 63 million pounds. In 1983, the Nuexco forecast calls for production to drop to 95 million pounds U_3O_8, and, as noted above, consumption will increase to 80 million pounds. This gives rise to hopes that production and consumption are finally being brought into balance. However, Nuexco forecasts for 1984 and 1985 suggest otherwise. Production for those two years will be 95 million and 104 million pounds U_3O_8 respectively, while consumption will be only 83 million and 87 million pounds. Annual additions to inventory will continue, albeit at reduced rates, but these gross figures don't tell the full story, for a good deal of this material is being delivered to buyers who don't need it and who have little choice but to resell it.

The obvious outcome is, of course, excess and continued growth of inventory. Much of this inventory was and is held by those who can least afford to hold it or who have the least need for it. Cancellations and deferrals of nuclear projects and high interest rates led to inventory liquidation, a condition which has dominated the market since 1981. Uranium spot prices went from more than $40.00 per pound U_3O_8 to $17.00 before rebounding to $24.00. Secondary market conversion prices in the United States are but a third of prices in the primary market. Secondary market SWU prices plunged first to the $102 to $107 range and then lower after DOE announced its Interim Sales Contract. The uncertain success of the ISC and the unknown terms of the promised, but as yet unseen, Utility Services enrichment contract have left the SWU market confused.

None of the above is particularly new news to this audience. Depending on your particular interests, you may like or dislike the current situation, but your particular wishes and desires are largely immaterial. The market has a mind of its own. It doesn't much care what you or I individually may think about it.

How Did We Get There?

Initially there was the incredible optimism that rippled through the utility industry worldwide in the late 1960s and early 1970s. From the largest national utilities in the industrialized West to small, Third World countries, everyone was going to go nuclear. In the diverse U.S. market, the range was equally great, with the likes of a Commonwealth Edison, Duke and TVA at one extreme and small public power districts at the other. Electric usage was growing at 7% annually. Capacity had to double every 10 years. The oil embargo provided additional impetus. It is difficult to recall accurately the full extent of the enthusiasm. We were headed towards a nuclear Valhalla.

In response, the industry's infrastructure began to develop to meet the enormous demands for materials and

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services associated with this dramatic growth business. Thus, in the mid-1970s, DOE closed its order book, concerned about having adequate enrichment capacity; warnings were heard about a possible shortage of conversion capacity; uranium prices surged as buyers rushed to get theirs before it was all gone. In 1975, it was predicted that, by 1985, US uranium consumption alone would exceed 100 million pounds U_3O_8 annually. I distinctly remember this concern and the specific comment: "Just think, every year we must find and put into production a new Mt. Taylor." Thus developed the overcapacity and the attendant overproduction that plague the industry to this day.

Now, with the advantage of 20-20 hindsight, we can observe the Three Mile Island incident as a watershed event. I don't believe that TMI, in and of itself, caused anything to happen that would not have happened of its own accord in time. Indeed, high interest rates, escalating costs, regulatory delays and, above all, low growth rates had set the stage for a structural change in the nuclear industry. And, while delays and cancellations had occurred prior to March 1979, it is now clear that Three Mile Island caught the attention of people in the executive suites as had no previous event. It focused concerns and catalyzed action. A trickle of deferrals and cancellations became a flood. Large nuclear utilities became small nuclear utilities, and small nuclear utilities packed it up completely.

The fuel markets, of course, felt the full brunt of these decisions as excess inventories were liquidated. Uranium prices broke sharply lower, and discounted secondary markets developed for conversion and SWU. Hardly a surprising development, as non-nuclear utilities have little need for U_3O_8, conversion, or SWUs.

And everyone missed the early warning signs. When I say everyone, I mean all of us—utilities, producers, converters, enrichers, consultants *and* brokers. The handwriting was on the wall, but we refused to see it primarily because we didn't want to. However, and this acknowledgement is long overdue, there was one individual who called the tune with uncanny accuracy years before any of the rest of us. I refer to Vince Taylor of Pan Heuristics. He was much maligned within the industry at that time, but his two papers "The Myth of Uranium Scarcity" published in April 1977 and "How the U.S. Government Created the Uranium Crisis (and the Coming Uranium Bust)" published in June 1977 make very interesting reading today.

Where Are We Headed?

Excess capacity, excess production and large inventories which continue to grow lead me inescapably to the conclusion that spot prices will, at best, be volatile with buyers dominant, until the previously cited conditions are attenuated. I find it difficult to develop a convincing case for any substantial or sustainable price recovery while production continues to exceed consumption and substantial inventories are held in weak hands.

Enormous quantities of inventory have been liquidated since 1981. But equally large quantities have yet to be moved. There are numerous situations in which large inventory holders are suffering financial distress and/or have badly lagging nuclear programs. A particularly disturbing aspect of these situations is that inventories tend to be increasing at those very utilities which have the least need and can least afford it. They cannot be expected to hold it indefinitely. Common sense and economics demand its sale, as will regulators and rate payers. Inventory in weak hands makes for unpredictable markets. A sustainable upward movement in spot uranium prices and real recovery of the secondary conversion and SWU prices must await the redistribution of these excesses. The sixty-four dollar question is, of course, how long will all this take. I cannot foresee the future any better than any of you, but I doubt that we can accomplish what needs yet to be done in less than 12 months.

In my opinion, prices in these markets will continue to follow cycles even if and when the current imbalances are corrected. I recognize this may be contrary to the conventional wisdom and certainly contrary to current industry sentiment, which might be characterized something like this: "Once we manage to work off this damned inventory and bring supply and consumption into rough equilibrium we can all proceed on a more business-like basis."

I don't wish to suggest boom and bust cycles of the duration and severity experienced in uranium (i.e. $6 to $43 to $17), but periodic cycles nevertheless. My reasons are two. First is the nature of the basic utility charter; namely, reliable service at the lowest possible cost consistent with regulated rates of return sufficient to attract investment capital. Utilities are risk averse, and risk aversion translates into policies of conservatism. Too much too soon may not be desirable, but is infinitely preferable to too little or too late. A too much/too soon policy will, in aggregate, over time, dictate excess productive capacity being put in place earlier than required, be it uranium, conversion or enrichment. This will be followed, in turn, by liquidation, price weakness, diminution of capital investment, contraction, and finally by new concerns about future shortages, and higher prices as the cycle repeats.

Second, there is the sole-use-nature of uranium and its related fuel cycle services. Nuclear plants cannot be fueled with anything other than uranium. Coal, gas and oil are relatively interchangeable, and substitution does

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take place as prices change, just as happens in metal markets. Such is not the case for the nuclear fuel cycle.

I do not intend by these remarks to blame the utilities for anything. I appreciate their conservatism, and view the results as a necessary, even a desirable condition of their existence. I like cheap electricity, but I prefer expensive electricity to none at all.

A third general observation relates to the international nature of the market. The nuclear fuel business started in the international arena with the United States buying uranium from Australia, Canada and the Belgian Congo and with AEC as the monopoly supplier of enrichment services worldwide. But these and similar situations were characterized by large entities, usually governments, dealing on a large quantity, long-term basis. Recently we have seen individual utilities and other entities wheeling and dealing worldwide in the spot and secondary markets—wherever they can find some slight advantage. To me this reflects the growing sophistication and experience of fuel managers. I anticipate a continuing increase in international nuclear fuel commerce. This increase will occur in spite of ill-conceived attempts by governments to regulate you, *and*, perish the thought, to protect you and help you.

Some Specific Thoughts on the Future

With respect to the uranium market, it is increasingly the conventional wisdom that prices are moving up and will continue to do so. Those of you who have heard me speak before may recall that I tend to suspect conventional wisdom and look for reasons to take a contrary view. As the consensus of experts grows concerning the likely occurrence of some future event, so does my suspicion that the event in question will not occur. Personally, I remain concerned about overhanging inventories—held by producers and utilities alike. To be sure, much of this inventory is in the wrong form, or in the wrong place, or of the wrong origin, but these are all problems that can be solved with money. I'm not saying prices won't rise, for in the longer term they probably will. But I do say the market will remain extremely vulnerable to short-term price swings until more of that inventory finds its way into stronger hands.

The preceding comment is, of course, in the main directed to the spot market. However, as history has shown and despite protests by buyers and sellers alike, long-term uranium prices are influenced by spot prices. Consider this fact: three or four years ago long-term negotiated prices were in the range of \$43 to \$45 per pound U_3O_8; today long-term negotiated prices under these same contracts are in the range of \$33-\$35—a 30 percent reduction, even before one considers inflation. And the Euratom Supply Agency average price for deliveries under medium and long-term contracts has declined from \$36.00 per pound U_3O_8 in 1980 to \$33.25 in 1981 and to \$32.00 in 1982.

With respect to the conversion market, the situation is equally serious. Unlike the uranium market, most utilities already have intermediate or long-term contracts in place. Near-term supply swamps near-term demand. The level of secondary market conversion prices, about one third that of primary market prices, testifies to the imbalance. It is not inconceivable that the secondary conversion prices could temporarily go to zero, or even to a negative value, as UF_6 sellers attempt to force sales to buyers who need U_3O_8. This suggests the possibility of contract cancellations and/or renegotiations. Ultimately, of course, the best home for excess conversion is the converters themselves. This, in turn, would suggest production cutbacks sufficient to absorb the excess. The unique character of this market suggests that its recovery could lag that of the uranium market.

With respect to the SWU market, we have an even more interesting situation. First, DOE touted the Facility Requirements (FR) contract as the vehicle both to regain its competitive position in the world enrichment scene and to reduce the build-up of future SWU inventory. However, after a much criticized first draft, the FR contract never really saw the light of day. Secondary market activity increased, predicated on aggressive sellers with growing inventories of excess SWUs and the ability to create buyers through partial terminations under DOE's 3.5-year requirements contract. DOE grew increasingly restive about its loss of business to this secondary market, and frantic when such losses were to non-DOE sellers. The monopoly was being impaired.

With the avowed intention of restoring its monopoly position and closing off the secondary market, DOE, in late July, announced a quick fix for fiscal years 83, 84 and 85—the Interim Sales Contract or "mini deal," which essentially lowered the breakeven price by \$11.20 per SWU. Reaction was swift. Secondary market sellers dropped their prices to create new incentive, with the specific intention of demonstrating that a secondary market would continue to exist and that, consequently, the 3.5-year holders shouldn't accept the mini-deal.

It is, however, premature to offer a final verdict on the mini-deal. While some utilities have accepted it and some are reportedly ready to accept, others have indicated they will not accept. On the other hand, certain things are clear: secondary market prices have been driven sharply lower; there is spirited competition between sellers at

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these lower levels; and prices are approaching the level where 5-year requirements contracts could come into jeopardy, notwithstanding their higher termination charges.

The next step in the DOE campaign is expected to be the Utility Services enrichment contract (USEC). Its terms and conditions are reportedly designed to motivate conversion by the 3.5-year requirements contract holders, removing them as buyers of secondary market SWUs. Lacking access to the specifics, it is impossible to comment further at this time. I would judge, however, that it will be very difficult for DOE, or anyone else for that matter, to make the secondary market go away. The 3.5-year requirements contract is enormously attractive. It is very flexible. It provides unique access to a world awash in SWUs and aggressive sellers trying to dispose of their excesses. Why would a utility willingly cut itself off from such possibilities and give up such flexibility? As a utility, I can think of no better situation than being one of the few holders, and preferably the last holder, of 3.5-year requirements contracts.

Spot and Secondary Markets

At the outset, I would comment on certain characteristics of the markets for uranium, conversion and enrichment. Primary and secondary markets exist for each. For our purposes, I define a primary market as one in which the entity producing the product or service is the seller. This would include uranium producers, converters and enrichers. Similarly, I define a secondary market as one in which the end user becomes the seller, usually with the intent of disposing of excess product or services.

In this regard, the conversion and SWU markets are reasonably alike: the primary market is characterized by suppliers dealing with customers on an intermediate to long-term basis; price levels are either public information or generally known; suppliers do not compete at secondary market price levels; each market is characterized by a small group of sellers—with only five WOCA converters and only three WOCA enrichers. Finally, the secondary markets for conversion and SWU are true secondary markets, with end users dealing exclusively with other end users. To date, the suppliers have not appeared in the secondary market as either buyers or sellers.

Compare this situation with that found in the uranium market. Indeed there is a primary market characterized by uranium producers with large reserves dealing with end users on a long-term basis. But while some average prices are published, there is no defined, universally accepted long-term price. And in the markets for spot and near-term delivery, primary and secondary activity is so interwoven that the markets are indistinguishable. Primary suppliers appear as both buyers and sellers, sometimes even on the same day, as do end users. Production is reduced or terminated in favor of open market purchases when economics dictate. Thus, this market has come to be called simply the spot market—even though it often includes transactions for near term and even intermediate term delivery. More importantly, however, and unlike the conversion and SWU markets, the spot price for uranium has had substantial and direct effects in two areas: first, it affects the annual price negotiations under long-term contracts with provisions for such negotiations; and second, it influences the price obtainable in new contracts at any given point in time.

Another important attribute of the spot and secondary markets is their visibility. One has only to pick up the most recent edition of *Nuclear Fuel*. Only for these markets are regular price series published. Nuexco and its worthy competitors are often criticized for our participation in and reporting on the spot and secondary markets. The reporting of uranium prices and secondary market conversion and SWU prices is viewed as destructive by producers if, in their view, prices are too low, and viewed as destructive by utilities if they believe prices are too high. Today, of course, many producers are unhappy. Such prices are not seen as indicative of the cost of producing uranium, conversion or SWU, nor indicative of the true value of these items, nor indicative of the current long-term contract price, nor indicative of the price necessary to sustain the industry over time.

All the above is true. Spot and secondary markets don't have to meet these tests. You may like the spot price or hate it—but that won't change it. The fact of the matter is that if you go out to buy or sell uranium for spot or near-term delivery, you know and I know the price is going to be somewhere near Nuexco's Exchange Value or Nukem's quote. And, if you elect to deal in the secondary market for conversion or SWUs, you will achieve similar results. Even if all the brokers and consultants were to disappear overnight, the spot market and secondary market would continue to exist. These markets were not invented by brokers; they developed because of the need to redress imbalances in the marketplace.

As DOE grew increasingly and vocally concerned about the secondary market, references were made to the avalanche of secondary market SWUs, the need for a "rational" market and the need to dry up the secondary market. Where did the avalanche come from? Each and every SWU was a primary market SWU before it became a secondary market SWU. How does one make a secondary market go away? Since increased consumption can-

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not be mandated, the answer seems obvious—production should be reduced. The only other alternative is to force SWUs on customers who neither need nor want them—which action increases utility costs and, of course, fuels the secondary market.

It is interesting in the face of the need to correct the current imbalances that some primary producers of uranium, conversion and SWUs, and particularly the SWU producers, view the secondary market as an amoral creation. They appear to resist the view that these markets are the result of the free market in action, and are an essential activity to effect the required redistribution of excess material and services. Much of today's market turbulence might well have been avoided had these markets functioned earlier and more actively.

The increased efficiency of these markets has led to an uncomfortable situation for primary suppliers. The ability of end users to acquire material and services in the secondary and spot markets, at what are viewed as bargain prices, has allowed end users to defer contracts, cash flow and earnings for the primary suppliers. Moreover, the large quantities available allow end users to acquire base load from spot and secondary sources, as opposed to using these sources merely to top off and fine tune their needs. Thus, we see end users utilizing these markets to purchase entire first cores, or reload batches on a regular year-by-year basis.

In some cases, these markets are used in place of more conventional longer-term purchases. When spot or secondary market prices are sufficiently below primary prices, it becomes more economical to buy and hold than to conclude the more conventional long-term contract. Simply stated, and depending on the current availability of cash, if today's price plus carrying costs is less than the estimated price to be paid at some future date, a spot or secondary market purchase may be judged more economical. While painful to primary suppliers in the short term, such purchases do result in clearing out the inventory overhang.

If weak secondary markets and weak spot markets result from the redistribution of excess goods and services, it would seem logical to eliminate the imbalance. Yet SWU contracts produce more SWUs than are consumed. Conversion contracts feed UF_6 to the SWU machines, and uranium producers deliver U_3O_8 to converters for conversion into UF_6. Since we know full well we cannot increase consumption, there seems but a single, simple answer. Perish the thought, we should rationalize the market by reducing production. Fortunately, we don't have to make such decisions. The spot and secondary markets will continue to force decisions. It is not unreasonable to believe that a uranium spot price of $17.00 had something to do with the sharp decrease in uranium production. Neither is it unreasonable to observe that the secondary SWU market has driven DOE to consider offering improved and more flexible enrichment contracting terms.

Finally, I would comment on one particular aspect of today's markets, and that is the creativity of transactions, particularly those in the secondary markets. Uranium producers, converters and enrichers must look beyond the supply/demand balance in their individual markets. If 29,200 kgs of 3.0 percent enriched product is involved in a de-enrichment/deconversion swap at a 0.30 percent tails assay, the resulting products include 100,000 SWUs, 192,000 kgs of conversion and 500,000 pounds U_3O_8. Such transactions are becoming industry standard, and serve to tighten the interrelationships in the front end of the fuel cycle. Thus, uranium producers and converters need to watch and understand the enrichment scene, and uranium producers need to be aware of the conversion situation. As if this were not enough, let me suggest another step. We have deconversion, and we have de-enrichment; have you considered defabrication? It is, in fact, being considered.

In conclusion and because naming names is bad form, I must take note of that friendly, fictitious electric utility company, North-South Public Service, which has recently become a non-nuclear utility. Does anyone in this room seriously believe that North-South Public Service should be purchasing uranium to feed its conversion contract to provide UF_6 to meet its enrichment obligations for a now, nonexistent plant? I certainly hope not. But if there are some here who do believe that, let me say only this—Welcome to the Fuelish Cycle.

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NUEXCO

ANOTHER COMEBACK FOR URANIUM

By

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Vice President
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Presented By:

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Presented To:

Society of Petroleum Engineers of AIME
58th Annual Technical Conference and Exhibition

San Francisco, California
October 5-8, 1983

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ANOTHER COMEBACK FOR URANIUM

By: Thomas A. Boyden
Vice President
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Abstract

The uranium market has been unstable since private industry entered the nuclear power generating business in the early 1960s. Uranium supply has always exceeded demand throughout the Free World. In 1982, production was 106 million pounds U_3O_8 and accumulated inventory totaled over 400 million pounds; consumption was only 63 million pounds. Recent inventory selling, production cutbacks and producers buying from consumers, have led to decreasing prices and further market instability.

It now appears that the market is beginning to change to a more stable situation. Current forecasts indicate that Free World demand will almost double by 1996, led by Europe and the US. Annual production will average about 110 million pounds during the same period. A closer balance between supply and demand should allow market prices to improve between now and 1990.

The situation in the US is more complex. Consumption will increase to 39 million pounds through the 1990s while annual production is expected to decrease to about 12 million pounds (down from a 1980 high of almost 44 million pounds), before higher prices allow extended recovery to an annual production level of about 22 million pounds. The balance of US consumption will be met with imports and inventory drawdowns. Higher prices in the latter part of the decade will support a number of new solution mining projects, and allow the development of high-grade ore deposits by conventional methods. The US producer industry will survive, but will be secondary to those in Canada, South Africa and probably Australia.

Introduction

Uranium is a unique mineral. It has only one industrial use. It is the principal fuel commodity for nuclear power. Every industrial nation and many developing nations already have nuclear power installations, or are presently considering it as a future power source. Even so, the nuclear power industry has not developed as earlier expected throughout the Free World. The growth rate of the industry slowed sharply in response to a sagging world economy and a sharp decline of industrial power demand. The future of the industry remains uncertain, even as economic recovery seems close at hand.

Another comeback for uranium implies that the uranium production industry will recover with new mines starting up and old production centers returning to full work schedules. The recovery will not be that strong. Presently, the industry is suffering from excess productive capacity, excess production, increasing inventories and low prices.

Nuclear Power Growth

Further development of the uranium supply industry is dependent on continued expansion of nuclear power generation. Nuclear generating capacity is expected to increase from 146 gigawatts (GWe) as of 1982 to approximately 360 GWe in 1996. This is a compound increase of about seven percent per year, compared to long-term electrical load growth estimated at 2.8 percent per year.

The 1982 capacity of 146 GWe was generated by 199 operating plants in 23 countries and 78 operating plants in the United States. The expansion to 360 GWe by 1996 is projected on the successful completion and operation of 175 plants now under construction outside the US and 59 plants in the US.

Nuclear generating capacity will increase in the US from the installed 58 GWe in 1982 to about 111 GWe by 1992. Further growth will not occur because additional plant orders are not expected before 1990. Plant lead time is presently 12 to 14 years, but this could decrease to 8 or 10 years by the end of the decade if licensing schedules are streamlined. Nuclear generating capacity in the US may not show further increase prior to the year 2000.

Nuclear power offers considerably greater economic advantage in Europe and the Far East than in the US. Coal in Britain and Germany represents the only indigenous energy resource available in Europe. Other substantial resources and alternate power sources are too expensive throughout Europe and the Far East. Regardless, only two countries currently have sustained nuclear programs, France and Japan. France has the most aggressive building program, presently at 24 GWe and increasing to almost 63 GWe by 1996. Nuclear capacity may comprise 60 percent of France's electric generating capacity by that time. By comparison, nuclear capacity in the US will represent only 15 percent or less of total generating capacity by 1996.

Japan is totally dependent on imported energy resources. The disruption of oil deliveries in the early 1970s created new incentives for Japan to diversify its electric power base. The Japanese are converting oil-fired plants to coal and LNG, and are building new coal, LNG, hydro and nuclear plants. Japanese nuclear power capacity of

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17 GWe in 1982 is projected to increase to 46 GWe by 1996.

The amount of installed electric capacity in West Germany is among the largest in Europe. It was developed over the years to support Germany's large industrial base. However, the nuclear power program has been affected adversely by regulatory and licensing problems. The immediate need for nuclear power was postponed as a result of long-term development of low-grade coal resources and more recently, the availability of North Sea oil. Now, nuclear power appears to be the only remaining alternative for sustaining industrialization. The German nuclear program is gradually moving forward. It is expected to more than triple from the 1982 level of 10 GWe to approximately 36 GWe by 1996.

It is generally concluded that nuclear power programs throughout the rest of Europe and the Far East will continue to move forward, but on greatly diversified schedules. Spain and Italy are faced with curtailed programs due to political and plant siting problems, but both have plans to expand throughout the 1980s and 1990s. The construction program in Sweden is developing on a schedule to increase from the 1982 capacity of 6.8 GWe to 9.4 GWe in 1988. The current building program ends in 1888 and generating capacity remains at 9.4 GWe through 1996. Korea and Taiwan had aggressive construction programs which only recently were curtailed for economic reasons.

Programs in the United Kingdom and the United States appear to be less critical to the economic and industrial growth of each country. Both have large coal, oil and gas generating programs. However, each country had large nuclear construction programs underway prior to the "energy crisis" of the mid-1970s. The programs were cut back considerably by lack of electrical load growth due to energy conservation. Additional pressure of changing plant economics, and political and social delays resulted in the cancellation of many nuclear power plants. In the US alone, 101 plants have been canceled since 1975 (out of 251 plants ordered since 1955). The nuclear programs in both countries are being adjusted to changing demand patterns. Construction of new plants is progressing, but at a rather slow rate.

Uranium Consumption

Uranium consumption is a direct function of in-place nuclear generating capacity. It describes the amount of uranium processed annually for the operation of a reactor. Nuexco has analyzed consumption on a reactor-by-reactor basis for each country, with attention to internal economics, current energy consumption, national energy alternatives and related economics of nuclear power. Final analysis includes technical improvements in nuclear plant and fuel performance. Public opinion and politics are unpredictable factors that can have considerable influence on a particular nuclear program. The US is a case in point. Orders for new nuclear power plants have been postponed in several states by legislation based on the need for a demonstrated disposal method of spent nuclear fuel.

Free World consumption was 63 million pounds U_3O_8 in 1982. It is predicted by Nuexco to increase to 136 million pounds in 1996. The exponential growth rate for that period is about five percent per year.

United States consumption will increase from 21 million pounds in 1982 to about 35 million pounds in 1992, maintaining that level through 1996. If new plant orders are not forthcoming before the 1988-90 period, consumption will remain at 39 million pounds per year beyond the year 2000. The steady increase in consumption over the next six to eight years will outstrip US production. Consequently, US utilities will have to import uranium to satisfy requirements.

Inventory Position

Uranium consumption has always been less than supply. As a result, Free World inventories have been growing annually. Inventory is the commercial accumulation of uranium held by consumers. It is herein expressed as pounds of U_3O_8 equivalent, although it may be U_3O_8 concentrate, natural UF_6 or enriched UF_6.

The inventory imbalance is distributed among most users, but primarily those outside the US. Large inventories are held by France, Germany, United Kingdom and Japan. In fact, total Free World inventories in all stages of the fuel cycle are currently estimated at over 400 million pounds U_3O_8 equivalent, or about 5 years of forward consumption.

A survey by Nuexco indicates that, in general, utilities will not let inventories be drawn down to zero. Each would maintain a minimum forward inventory adjusted to future consumption schedules. It is assumed by Nuexco that minimum inventory levels will be maintained as follows: Europe, 3 years; Far East, 4 years; United States, 1.5 years.

As consumption increases and production levels off during the next few years, the Free World inventory situation will stabilize by about 1988 and then decline to the

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near desired levels by the 1994-96 period. The inventory position of the US should reach a normal mode by 1988.

The US held about 35 percent of Free World inventory in 1982. By Nuexco's estimate, that percentage will decline to about 13 percent by 1996. Inventories outside the US will peak about 1990 and gradually decline to the acceptable inventory level by the 1990-96 period.

Production

Uranium mines and mills currently in place throughout the Free World have the capacity to produce approximately 160 million pounds U_3O_8 annually. The figure has increased with the commissioning of the Key Lake mine and mill located in northern Saskatchewan. However, due to an annual oversupply situation, curtailment of production is expected in every major production center except Canada and South Africa.

Actual production during 1982 was 106 million pounds, down from 112 million in 1981. Production will be down to 95 million pounds in 1983. The decline can be attributed primarily to curtailment of US production since 1980. High-cost US producers are closing their facilities and are being displaced by inventory selling and lower cost production in Canada and elsewhere. Certain US producers have stopped producing in favor of buying low cost inventory material to fill higher priced delivery contracts. Not until inventory selling runs its course will consumers return to buying from producers.

Free World production originates from eight different countries. At the end of 1982, Australia produced 12 percent of world total, Canada 22 percent, Namibia 11 percent, Niger and Gabon 11 percent, South Africa 16 percent, the United States 16 percent, and all others including Europe 12 percent. By 1990, the US share of production will have decreased to about 13 percent and Canadian production will have increased to about 31 percent, almost entirely from northern Saskatchewan. Other market shares will be down slightly. South Africa will remain about the same.

The Producer Industry

The industry's response to nuclear power forecasts of the early 1970s resulted in overcapacity and overproduction. Later plant cancellations and construction deferrals added to an unpredictable situation. Utilities became sellers of excess uranium in direct competition with primary producers. Uranium prices declined sharply from $40 per pound U_3O_8 in early 1980 to a low of $17 by mid-1982. Many production centers curtailed activities or closed down facilities, primarily in the US.

Although the spot price recovered to $24.00 by September 1983, it remains well below the level required to justify most new production ventures or the reopening of shut-down properties. This is especially true in the US where the cost of production is no longer competitive with certain non-US producers. US production will drop below consumption for the first time this year. US utilities will be forced to import uranium to meet their requirements. Nuexco estimates that US utilities' unfilled requirements will increase annually from three million pounds in 1983 to over 30 million pounds by 1994.

The United States represents the largest market for intermediate and long-term unfilled requirements. The comeback of the uranium industry is tied to the unfilled requirements of the US. The Canadian industry will be the main beneficiary in filling a large part of the requirements. Certainly South Africa is in a favored position to benefit; the potential of other African nations is less certain. Australian uranium could be included but probably not before 1988 or 1990.

Acquiring large quantities of uranium from foreign producers is not without potential problems to US utilities. A seller may be subjected to a variety of economic, political and social circumstances that could limit or eliminate buyer interest. Canada, for instance, will allow uranium to be exported only in the form of UF_6. Certain US utilities take exception to this policy because they already have long-term conversion contracts with US converters.

The uranium producing nations in Africa are South Africa, Namibia, Niger and Gabon. Each nation could definitely be a seller to US utilities. In fact, a limited amount of South African material has already been sold in the US. However, each nation has complex political, social and economic problems. US buyers' attitudes are influenced by their internal policies as well as by outside pressure from political groups. Uranium purchases from the African nations will be limited for some US utilities.

Australia has the world's largest known uranium resources. The two operating mines have a combined production of 11 million pounds per year. None of that production is sold to US utilities. Development plans of other important deposits are currently caught up in unfavorable industry economics and the political opposition of the Labor Party. Those two problems will probably keep Australia out of the US market for at least the next five to ten years.

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Summary

US producers will supply about 15 percent of world uranium production and about 45 percent of domestic requirements well into the 1990s. US utilities will look to US producers as an assured source of supply. The industry will be restructured to consist of more small in situ leach projects and fewer underground mining operations. A few new producers will develop in situ leach mines in Wyoming, Texas and Nebraska. Also, one new open pit mine may start up in Virginia. US production will recover from the projected low of 12 million pounds U_3O_8 per year and expand over time to about 16 million pounds per year.

Uranium production will increase in Free World countries outside the US through expansion of existing projects and addition of new projects. US producers primarily will augment world production. It is doubtful, however, that the US production industry will ever again be as big as it was in the boom years.

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MONTHLY REPORT ON THE NUCLEAR FUEL MARKET

November 1983 No. 183

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To Our Readers

On October 21, Nuexco's chairman and chief executive officer, Mr. J. R. Wolcott, testified before the US House of Representatives Subcommittee on Energy Conservation and Power about the secondary market for enrichment services. A Special Report to be issued this month to Category I and II subscribers will include his testimony and excerpts from testimonies presented by the US Department of Energy and other witnesses.

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NATURAL URANIUM

The **Exchange Value** as of October 31, 1983 is **$23.50** per pound U_3O_8, down $0.50 since last month, marking the first drop in the Exchange Value in fourteen months. The *Current Market Data* section of this Report lists three uranium sales, involving approximately 275 thousand pounds equivalent U_3O_8. Two transactions involved enriched UF_6 and one involved concentrates.

Active spot and near-term uranium supply (U_3O_8 or natural UF_6 offered at competitive prices, terms and other conditions) totals **5.9 million** pounds equivalent U_3O_8. **Active spot and near-term demand** for natural uranium totals **3.1 million** pounds equivalent U_3O_8. Therefore, the spot and near-term **supply-demand ratio** rose slightly to **1.9:1.**

The **Transaction Value** as of October 31, 1983 is **$23.65** per pound equivalent U_3O_8, unchanged from last month. The current Transaction Value includes 21 transactions involving a total of 2.0 million pounds equivalent U_3O_8 and covers a period of six months.

The **Loan Use Charge Rate** as of October 31, 1983 is **6 percent** per annum, unchanged since last month in this moribund market segment.

* * *

This month's $0.50 fall in the Exchange Value came about as the result of sellers' efforts to stimulate buyer activity. Even in the face of offering prices being lowered for the first time in fourteen months, potential buyers remained hesitant to make commitments. Many potential buyers, lacking near-term needs, are content to wait for an exceptionally attractive opportunity. As the end of calendar year 1983 approaches, buying activity is likely to increase. For example, at press time, one fairly large transaction was in the final stages and, barring some unforeseen difficulties, will be included in next month's Report.

SECONDARY MARKET CONVERSION SERVICES

The **Conversion Value** as of October 31, 1983 is **$0.60** per pound U as UF_6, down $0.40 since last month. Even though sellers dropped their prices by large margins during October, buyers remained selective. *The Current Market Data* section lists one secondary market conversion transaction, involving 101-300 thousand pounds U. Active secondary market supply of conversion services for delivery within three years totals 5.3 million pounds U as UF_6, while the corresponding demand figure is 2.1 million pounds.

Secondary market prices for conversion have fallen in recent months as a reaction to the fact that demand is virtually all discretionary. On the other hand, much of the supply in this market segment is associated with U_3O_8 or enrichment transactions of great value. Sellers are less price sensitive to the conversion component of these larger transactions.

SECONDARY MARKET ENRICHMENT SERVICES

The most important development in the secondary SWU market during October was DOE's modification of its July 25, 1983 offer of the Interim Sales Contract (ISC). DOE's October 18 letter to holders of Requirements contracts containing 3.5-year termination provisions summarized the two significant points of the new contract form.

1. It allows the customer to obtain on the secondary market *without termination charges* up to 40 percent of requirements for FY84 (60 percent for FY85), provided that both buyer and seller certify in writing that the secondary market SWUs are of US origin.

2. Those accepting the modified ISC must agree to convert to the Utility Services enrichment contract (USEC) when offered, provided that its terms are "no less favorable than those in the customer's existing Requirements-type contract when considered in its entirety." DOE has also offered to modify the few existing ISCs in accordance with the latest offer.

The latest DOE move has two clear objectives:

1. To stop the purchase of non-DOE SWUs in the secondary market by 3.5-year Requirements contract holders;

2. To facilitate the secondary market sale of excess DOE-origin SWUs, primarily by holders of AFC contracts.

At press time, the secondary SWU market was still adjusting to DOE's action, but several *preliminary* observations are possible.

1. The requirement to convert to the still unrevealed USEC is making many customers hesitate to accept DOE's offer. Virtually all utilities for which the modified ISC is an option have deferred any decision until their legal departments complete a thorough review of the actual contract language, so as to determine how binding such a commitment might be.

2. Sellers' offering prices for non-DOE SWUs have dropped and those for DOE SWUs have risen. The

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differential between non-DOE and DOE-origin offering prices has increased to approximately $30. Thus, a two-tiered market has arisen.

3. Before DOE offered the modified ISC, the secondary SWU market had been characterized by a single class of potential buyers made up of those DOE customers holding 3.5-year Requirements contracts. Sellers of DOE SWUs competed directly with sellers of non-DOE SWUs for the buyers, which were free to buy SWUs of any origin. Now, every customer that accepts the modified ISC will add to the segmentation of secondary market SWU demand into two classes. One group of buyers will be able to accept only DOE SWUs. The other group of buyers, though theoretically able to accept SWUs of any origin, essentially will be forced to purchase non-DOE SWUs because of the high differential between the two prices.

4. DOE has said it will continue to offer both types of ISC, the original and the modified forms, so it is possible theoretically for the buyers to be split into three groups. Potential buyers that accept neither ISC, but that are able to purchase SWUs in excess of their cumulative ceilings, will also have different motivations, so even a fourth class of buyers is possible, in theory.

5. Prices for non-DOE SWUs are now so low on the secondary market that holders of 5-year Requirements contracts could very well find it worthwhile to terminate their DOE deliveries, pay the 40 percent termination charge, and buy non-DOE SWUs on the secondary market. Thus, DOE is considering making an ISC offer available to 5-year Requirements contract holders; if it does, that group could become split as well.

6. At present, the market seems to be heading toward some degree of fragmentation with respect to the buyer group. However, it is essential to note that estimates of the degree of fragmentation that will take place are based only on informed speculation, at best. The market has not yet sorted itself out. It is not clear how many—and more importantly, which—holders of 3.5-year Requirements contracts will accept either ISC. The degree of market acceptance of the ISC will determine the future character of the buyer-seller relationship in the secondary SWU market.

This month's Report contains two SWU Values, reflecting Nuexco's best judgment of the conditions necessary to conclude secondary market SWU transactions. The **non-DOE SWU Value** is **$85** per SWU, for delivery within approximately 15 months. The time period chosen is intentionally flexible to reflect the way in which sellers of non-DOE origin SWUs structure their offers to sell. The SWU Value for **DOE-origin SWUs** is **$115** per SWU. That value refers to delivery in FY84, again reflecting the way in which sellers structure their offers. Both values are referenced to a tails assay of 0.20 weight percent U^{235} (the transaction tails assay for the holders of Requirements contracts). Depending on the values assigned to U_3O_8 and conversion, the equivalent price at a tails assay of 0.30 percent might be $6-8 higher. In this context, the equivalent price is that which would yield an identical cost of enriched product.

Three points are important to consider regarding this month's SWU Values.

1. The values are based on seller's offering prices in the absence of bids and relevant transactions. That is not to say that the SWU Values were set at the lowest offer. Rather, Nuexco examined the available data on sellers' offers in conjunction with other information about the market—such as the likely response of the market to the modified ISC—and came to judgments of the prices at which transactions could take place. While the *Current Market Data* section lists four SWU transactions this month (total quantity approximately 400 thousand SWUs), all four were executed on the basis of market conditions prevailing before DOE's offer. Thus, they bear less relevance to the current SWU Values than they would have done otherwise.

2. The present uncertainty is especially relevant to the SWU Value for FY84 delivery of DOE-origin SWUs. It represents a more substantial departure from recent price levels than does the SWU Value for non-DOE origin. Specifically, the existence of a two-tiered market depends on acceptance of the modified ISC by approximately 25 percent or more of the utilities with eligible contracts. If utilities overwhelmingly reject the modified ISC, there will be little market for DOE SWUs at prices near $115, and market prices will not be two-tiered. If, on the other hand, large numbers of customers accept the original ISC and large numbers accept the modified ISC, a three-tiered market is possible.

3. The secondary market is still adjusting to this latest DOE attack on the sellers of non-DOE SWUs. As of October 31, active secondary market supply of enrichment services for delivery within one year came to 1.1 million SWUs, while the corresponding demand was 600 thousand SWUs. Dramatic shifts are possible in the next few months as the market sorts itself out in response to the altered competitive environment.

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THE MODIFIED INTERIM SALES CONTRACT: ANALYSIS OF ITS EFFECT ON SWU PRICES

Table 1 illustrates the *short-term* choices available to the 3.5-year Requirements contract holder that is considering the modified ISC. Purchasing SWUs of non-DOE origin in the secondary market for $90 (the prevailing price at the time DOE modified the ISC), the buyer would pay a net price of approximately $127.50 per SWU ($90 to seller plus approximately $37.50 per SWU to DOE for the usual 25 percent termination charge). Accepting the modified ISC and buying 40 percent of the desired quantity in the secondary market for $102 (the prevailing price for SWUs of DOE origin at the time DOE modified the ISC), the buyer would reduce its average cost to $124 per SWU, saving approximately $3.50 per SWU compared to the other available choice.

Table 1

POTENTIAL SAVINGS ASSOCIATED WITH MODIFIED ISC

	Quantity[1] (thousands of SWUs)	Price (U.S.$/ SWU)	Cost (U.S.$)
Normal Cost of SWUs for Requirements Contract Holders			
FY 84 Requirements	200	149.85	29,970,000
Option 1: Buy Non-DOE SWUs in Secondary Market			
Secondary Market Non-DOE SWUs	200	90	18,000,000
DOE Contract termination charges	200	37.46	7,492,500
TOTAL COST			25,492,500
Option 2: Accept Modified Interim Sales Contract			
Secondary Market DOE SWUs	80	102	8,160,000
ISC (same price as fixed commitment)	120	138.65	16,638,000
TOTAL COST			24,798,000
Option 1 - Option 2 = $694,500 = *$3.47* per SWU			

[1]For illustrative purposes, the table assumes a nominal quantity of 200,000 SWUs. Unit prices are independent of quantity.

In the example shown in Table 1, a price for non-DOE SWUs of $86.53 per SWU would have yielded the same average unit cost ($123.99) that the buyer would pay under Option 2 (accepting the revised ISC and buying 40 percent of FY84 requirements on the secondary market at $102 per SWU). Table 2 shows, for several different secondary market prices for DOE SWUs, the prices that theoretically would make buyers indifferent between the purchase of non-DOE SWUs and the purchase of DOE SWUs. The indifference prices do not include any provision for the amount of additional savings necessary to motivate buyers to select one origin of SWUs instead of the other.

Table 2

SECONDARY MARKET INDIFFERENCE PRICES

Secondary Market Price for DOE SWUs (US$/SWU)	Buyer's Average Cost per SWU (US$/SWU)	Equivalent Secondary Market Price for Non-DOE SWUs (US$/SWU)
100	123.19	85.73
102 (Table 1)	123.99	86.53
105	125.19	87.73
110	127.19	89.73
115	129.19	91.73
120	131.19	93.73

The calculation of indifferent prices listed in Table 2 uses the following derivation, where **SMP** is the **secondary market price for DOE SWUs** and **EP** is the **equivalent price for non-DOE SWUs.**

1. EP = 60%(ISC price) + 40%(SMP) - Termination Charge.
2. EP = 60%($138.65) + 40%(SMP) - 25%($149.85).
3. EP = $83.19 + 40%(SMP) - $37.46.
4. **EP = $45.73 + 40%(SMP).**

The price that a seller of non-DOE SWUs would actually have to offer would then be determined by subtracting from the equivalent price the amount necessary to motivate buyers to prefer non-DOE SWUs. The incentive amount depends on each buyer's particular attitudes toward non-DOE SWUs; in the past the incentive has been as much as $10.

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Prior to DOE's July 25, 1983 offer of the original ISC, a price of $112.39 in the secondary market enabled holders of 3.5-year Requirements contracts to break even after termination charges. At that time, in order to draw buyers, sellers of DOE SWUs needed to offer at approximately $108 (a $4 termination incentive), while sellers of non-DOE SWUs needed to offer at approximately $100, (an $8 incentive *below the DOE price*). Upon the announcement of the original ISC, the break-even price after termination for 3.5-year Requirements contract holders dropped by $11.20, to the level of $101.19. Consequently, sellers of DOE SWUs reduced their offering prices to the range of $95-100 and sellers of non-DOE SWUs reduced their offering prices to approximately $90.

The modified ISC places a higher premium on DOE SWUs because of the free termination clause. Secondary market prices for DOE SWUs are already rising to the neighborhood of $115. Sellers recognize that even at prices approaching $115, buyers that accept the modified ISC still can achieve considerable savings. Prices could move even higher but for anticipated competition among sellers. There is a large supply of short-term DOE SWUs in the secondary market. With DOE SWUs at the $115 price level, the equivalent price for non-DOE SWUs is $91.73.

Holders of 5-year Requirements contracts are not being offered the modified ISC (just as they were not offered the original ISC), so their indifference price is a simple function of the Requirements contract price and termination charges. Allowing for a 40 percent termination charge on 5-year Requirements contracts yields an indifference price of 60%($149.85) = $89.91, a figure less than $2 below the equivalent price for non-DOE SWUs when prices of DOE SWUs are $115. Thus, the secondary SWU market is approaching the point at which holders of 5-year Requirements contracts can be drawn into the market in large numbers.

A 3.5-year Requirements contract holder that decides to accept the modified ISC naturally will want to contract for DOE SWUs in the secondary market to reduce average costs below the AFC price of $138.65 that is included in the ISC. Restricted to purchases of DOE SWUs in the secondary market, the buyer is vulnerable to increases in the price for DOE SWUs. If the secondary market supply of DOE SWUs were to prove insufficient to meet demand, the price could approach (or slightly exceed) the $130 level. Any greater price would remove any incentive to act. A price of approximately $130 should be regarded as the short-term ceiling on the price of DOE SWUs in the secondary market.

Therefore, utilities that plan to accept the revised ISC will wish to arrange their secondary market purchases for both FY84 and FY85 as soon as possible, perhaps even before accepting the modified ISC. In Nuexco's opinion, secondary market sellers of non-DOE SWUs will also actively pursue the potential market for FY85. The price and availability of FY85 SWUs of non-DOE origin will be a factor in some potential buyers' decisions to accept or decline DOE's offer.

In that case, assuming that DOE prices for FY85 are unchanged from FY83-84 and assuming a price of $115 for FY85 SWUs of DOE origin, the equivalent price for non-DOE SWUs would become $94.49, using the following derivation.

1. EP = 40%(ISC price) + 60%(SMP) – the 20% Termination Charge for FY85.
2. EP = 40%($138.65) + 60%($115) – $29.97.
3. EP = 55.46 + 69.00 – $29.97 = $94.49.

It is very difficult to determine if the modified ISC will improve DOE's net income or if DOE would be better off allowing its 3.5-year customers to terminate and pay the substantial termination fees. A definitive analysis of the costs and benefits to DOE would require consideration of several variables, including:

1. the percent of buyers that accept the contract and the associated number of SWUs terminated and produced thereof;
2. the number of SWUs DOE is contracted with primary market buyers to deliver in the relevant FY;
3. the number of SWUs that DOE is scheduled with its power sources to produce;
4. the charge per SWU for power-not-taken;
5. the fixed and variable costs (including imputed interest) of SWU production;
6. the number of SWUs that DOE has in inventory;

and a range of other variables not immediately obvious. Nuexco's limited analysis suggests that DOE is unlikely to gain a substantial amount of revenue in the short term by offering the modified ISC, and could even lose money. In the absence of an obvious financial gain to DOE for offering the new contract, the only prominent motive for the offer seems to be the possibility of regaining a monopoly on the US enrichment market.

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CURRENT MARKET DATA

EXCHANGE VALUE $23.50/lb. U_3O_8
Determined as of October 31, 1983

Definition[1]

The Exchange Value is Nuexco's judgment of the price at which transactions for significant quantities of natural uranium concentrates could be concluded as of the last day of the month.

Derivation

Nuexco bases the Exchange Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Exchange Value:

A. The price of uranium delivered or to be delivered under old contracts.
B. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.

[1]In December, 1981, Nuexco published a history of the Exchange Value which chronicled, month-by-month, changes in its definition, usage and derivation. Copies are available upon request.

TRANSACTION VALUE[2]
Determined as of October 31, 1983

$/lb. U_3O_8	Millions of Pounds	Number of Transactions	Number of Months
23.65	2.0	21	6

Definition

The Transaction Value is a weighted average price of recent transactions, and is based on prices paid for U_3O_8 in transactions closed within the previous three-month period and for which delivery was scheduled within one year of the transaction date. At least ten transactions totaling at least two million pounds U_3O_8 are included in each calculation, or the sample time is extended as necessary to include these minima. Foreign currencies are converted to US dollars as of the transaction date.

Comments

Nuexco does not consider the following in determining the Transaction Value:

A. The price of uranium delivered in connection with contract renegotiations or other than arm's length transactions.
B. The price of uranium delivered in connection with contracts which call for "market price" mechanisms. This exclusion applies particularly to contracts in which delivery prices are expressed as a function of Exchange Value or any other independent variable. Also excluded from consideration are all data where the delivery price is defined in such a way that it cannot currently be determined.

[2]Transaction Values for 1976 through 1981 and their associated parameters (millions of pounds, number of transactions and number of months) are tabulated on pages 31 and 32 of Report 161. Corresponding data for 1982 are tabulated on page 5 of Report 173.

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CURRENT MARKET DATA

LOAN USE CHARGE RATE[1] 6%
Determined as of October 31, 1983

Definition

The Loan Use Charge Rate is Nuexco's judgment of the annual interest rate at which uranium loans could be concluded as of the last day of the month.

Derivation

Nuexco bases the Loan Use Charge Rate upon:

A. Data from recently completed or pending loan transactions.
B. Rates included in firm proposals to borrow or lend.
C. Rates that potential borrowers and lenders have expressed as a willingness to pay or accept, but for which Nuexco is not aware of firm proposals.

[1]Monthly data for 1968 through 1981 appear on pages 23-34 of Report 162. Monthly data for 1982 appear on page 2 of Report 173.

CONVERSION VALUE[2] $0.60/lb. U as UF_6
Determined as of October 31, 1983

Definition

The Conversion Value is Nuexco's judgment of the price at which spot and/or near-term transactions for significant quantities of conversion services could be concluded in the secondary market as of the last day of the month.

Derivation

Nuexco bases the Conversion Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.

Comments

Nuexco does not consider the following in determining the Conversion Value:

A. The price of conversion services delivered or to be delivered under old contracts.
B. The price of conversion services delivered in connection with contract renegotiations or other than arm's length transactions.
C. Transportation charges other than those customarily provided by primary suppliers of conversion services.

[2]Monthly data for 1981 and 1982 are tabulated on page 6 of Report 173.

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SWU VALUES

$115/SWU FOR DOE ORIGIN AND FY84 DELIVERY
$85/SWU FOR NON-DOE ORIGIN AND DELIVERY WITHIN 15 MONTHS
Determined as of October 31, 1983

Definition

The SWU (Separative Work Unit) Value is Nuexco's judgment of the price, expressed in U.S. dollars per SWU, at which transactions for the sale of significant quantities of SWU of stated origin for delivery in the specified time period could be concluded as of the last day of the month.

Derivation

Nuexco bases the SWU Value upon:

A. Data from recently completed transactions.
B. Data from pending transactions.
C. Firm bids to buy and firm offers to sell.
D. Prices purchasers have expressed a willingness to pay, but for which Nuexco is not aware of firm bids to buy, and prices sellers have expressed a willingness to accept, but for which Nuexco is not aware of firm offers to sell.
E. SWU prices at varying tails assays and varying product assays are converted to the equivalent SWU price at the DOE Reference Transaction Tails Assay (presently 0.20 weight percent U_{235}) and a product assay of three percent U_{235} assuming feed costs calculated using the Nuexco Exchange Value and Nuexco Conversion Value determined as of the last day of the same month.

Comments

Nuexco does not consider the following in determining the SWU Value:

A. The price of SWU delivered under long-term contracts from primary suppliers, such as DOE, Urenco, or Eurodif.
B. The price of SWU delivered under other than arm's length transactions.

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CURRENT MARKET DATA

EXCHANGE VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
Australia (dollar)	25.60	56.44	66.55
Belgium (comm. franc)	1,228	2,707	3,192
Canada (dollar)	28.96	63.84	75.29
Finland (markka)	132.92	293.04	345.56
France (franc)	187.85	414.14	488.37
FRG (mark)	61.63	135.87	160.23
Italy (lira)	37,480	82,629	97,440
Japan (yen)	5,469	12,057	14,218
Netherlands (guilder)	69.10	152.33	179.64
South Africa (rand)	26.87	59.24	69.86
Spain (peseta)	3,571	7,874	9,285
Sweden (krona)	183.36	404.25	476.71
Switzerland (franc)	50.03	110.30	130.07
UK (pound)	15.71	34.63	40.84
US (dollar)	23.50	51.81	61.09

TRANSACTION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U_3O_8 in Concentrates	per kg U_3O_8 in Concentrates	per kg U in Concentrates
Australia (dollar)	25.76	56.80	66.98
Belgium (comm. franc)	1,236	2,724	3,212
Canada (dollar)	29.14	64.25	75.77
Finland (markka)	133.77	294.91	347.76
France (franc)	189.05	416.78	491.48
FRG (mark)	62.02	136.74	161.25
Italy (lira)	37,719	83,157	98,062
Japan (yen)	5,504	12,134	14,309
Netherlands (guilder)	69.54	153.31	180.78
South Africa (rand)	27.04	59.62	70.31
Spain (peseta)	3,594	7,924	9,344
Sweden (krona)	184.54	406.83	479.75
Switzerland (franc)	50.35	111.01	130.90
UK (pound)	15.81	34.85	41.10
US (dollar)	23.65	52.14	61.48

[1]Calculated using currency exchange rates published in the Wall Street Journal on October 31, 1983.

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CONVERSION VALUE EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	per lb. U as UF_6	per kg U as UF_6
Australia (dollar)	0.65	1.44
Belgium (comm. franc)	31.35	69.11
Canada (dollar)	0.74	1.63
Finland (markka)	3.39	7.48
France (franc)	4.80	10.57
FRG (mark)	1.57	3.47
Italy (lira)	956.94	2,110
Japan (yen)	139.63	307.84
Netherlands (guilder)	1.76	3.89
South Africa (rand)	0.69	1.51
Spain (peseta)	91.19	201.03
Sweden (krona)	4.68	10.32
Switzerland (franc)	1.28	2.82
UK (pound)	0.40	0.88
US (dollar)	0.60	1.32

SWU VALUES EXPRESSED IN SELECTED PRODUCER & CONSUMER CURRENCIES[1]

Country (currency)	DOE SWU FY84	Non-DOE SWU delivery within 15 months
Australia (dollar)	125.27	92.59
Belgium (comm. franc)	6,008	4,441
Canada (dollar)	141.71	104.74
Finland (markka)	650.45	480.77
France (franc)	919.26	679.46
FRG (mark)	301.60	222.92
Italy (lira)	83,413	35,566
Japan (yen)	26,763	19,781
Netherlands (guilder)	338.14	249.93
South Africa (rand)	131.50	97.20
Spain (peseta)	17,477	12,918
Sweden (krona)	897.32	663.23
Switzerland (franc)	244.84	180.97
UK (pound)	76.87	56.82
US (dollar)	115.00	85.00

[1]Calculated using currency exchange rates published in the Wall Street Journal on October 31, 1983.

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CURRENT MARKET DATA

RECENT TRANSACTIONS[1]

Uranium Sales

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U_3O_8 equivalent)	Approximate Price as Percent of Current E.V.	Seller	Buyer	Remarks
2506A	1984	101-300	91	European Entity	US Utility	Enriched UF_6. Assumes $90 per SWU and conversion at $1.00 per lb. U as UF_6.
2511	1983	less than 50	103	European Utility	US Producer	
2512	1984	less than 50	102	Fabricator	Broker	Enriched UF_6. Assumes $100 per SWU and conversion at $1.10 per lb. U as UF_6.

Secondary Market Conversion Services

Nuexco Transaction Number	Delivery Period	Approximate Quantity (thousands of pounds, U equivalent)	Approximate Price as Percent of Current C.V.	Seller	Buyer	Remarks
2505	1984	101-300	183	US Utility	European Utility	

Secondary Market Enrichment Services

Nuexco Transaction Number	Delivery Period[2]	Approximate Quantity (thousands of SWUs)	Approximate Price[3] as Percent of Current SWU Value[4]	Tails Assay (Percent U_{235})	Seller Group	Buyer Group	SWU Origin	Remarks
2506B	1984	50-100	105	.2	European Entity	US Utility	Eurodif	
2521	1984	50-100	less than 78	.2	European Entity	US Utility	DOE	
2525	1984	50-100	89	.2	European Utility	US Utility	DOE	
2545	1986	101-300	indeterminate	to be determined	European Utility	US Utility	DOE	escalated base price

[1]Transactions listed are not limited to those in which Nuexco was involved, but also include others of which Nuexco is aware.
[2]Refers to quarter of calendar year, not fiscal year.
[3]Price is not normalized to 0.20% tails assay.
[4]Comparison to SWU Value for same origin as SWUs included in transaction.

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URANIUM SUPPLY
(As of 10/31/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1575	—	500 per year	1985-92
1818	—	500 per year	1984-90
2038	2,000	—	UF_6
2134	—	250 per year	1984-87
2189	280	80	enriched UF_6
2201	300	—	
2203	1,000	—	
2220	150	—	UF_6
2235	—	150 per year	1985-87
2236	—	200 per year	1985-89
2245	450	—	
2246	40	100	
2275	100	—	
2288	80	—	UF_6
2297	60	200 per year	1985-89
2307	200	—	UF_6
2315	150	950	UF_6
2320	350	—	UF_6
2365	20	—	
2366	600	—	
2376	100	—	U_3O_8 or UF_6
TOTAL:	5,880		
INACTIVE			
2017	—	2,300	
2271	—	500 per year	1984-85
2191	125	—	UF_6
2193	—	800 per year	1986-90
2309	950	—	
TOTAL:	1,075		

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

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CURRENT MARKET DATA

URANIUM DEMAND
(As of 10/31/83)

Nuexco Project Number	Spot or Near-term[2] (Delivery Period[1] Thousands of Pounds U_3O_8)	Intermediate or Long-term (Delivery Period[1] Thousands of Pounds U_3O_8)	Remarks
Inquiries to Purchase:			
ACTIVE			
1459	—	200 per year	1985 on
2167	250	250 per year	1984-89
2187	120	—	
2188	—	250 per year	1986 on
2233	700	—	U_3O_8 or UF_6
2238	270	—	enriched UF_6
2266	450	—	
2302	—	250 per year	1987 on
2304	—	500 per year	1987 on
2310	800	—	enriched UF_6
2313	260	255	
2329	—	500	1985
2357	130	—	enriched UF_6
2372	—	250 per year	1985-88
2393	45	—	enriched UF_6
2416	—	430	
2419	50	—	
TOTAL:	3,075		
INACTIVE			
1999	—	50 per year	1985-90
2010	—	400 per year	1984-92
2025	—	350	
2114	—	75 per year	1984 on
2118A	250	—	
2371	—	260	1984-90 UF_6
2244	—	350 per year	1985 on
TOTAL:	250		

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

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LOAN SUPPLY AND DEMAND
(As of 10/31/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U_3O_8) Within 1 Year	Beyond 1 Year	Remarks
Available for Loan:			
ACTIVE			
1815	1,000	—	UF_6
1938	1,500	—	UF_6
2128	1,000	—	
TOTAL:	3,500		
INACTIVE			
1884	600	—	
2036	500	—	UF_6
2139	2,000	—	
TOTAL:	3,100	—	
Inquiries to Borrow:			
ACTIVE			
2118	250	—	U_3O_8 or UF_6
TOTAL:	250		

[1]Measured from the date of this Report

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CURRENT MARKET DATA

CONVERSION SUPPLY
(As of 10/31/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
ACTIVE			
1936	1,500	—	
2051	1,500	—	
2141	1,500	—	
2143	300	—	
2220	400	—	
2222	80	175	
TOTAL:	5,280		
INACTIVE			
1609	1,500	—	
2181	2,000	650 per year	1985-90
2230	300	—	
2401	600	—	
TOTAL:	4,400		

CONVERSION DEMAND
(As of 10/31/83)

Nuexco Project Number	Delivery Period[1] (Thousands of Pounds U as UF_6) Within 3 Years	Beyond 3 Years	Remarks
ACTIVE			
2129	900	—	
2380	700	—	
2386	190	—	
2420	300	—	
TOTAL:	2,090		
INACTIVE			
2190	400	200 per year	1986 on
2194	—	300 per year	1986 on
2287	250	250	
2295	200	—	
TOTAL:	850		

[1]Measured from the date of this Report.

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SWU SUPPLY
(As of 10/31/83)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Available for Sale:			
ACTIVE			
1859	—	1,000	
2100	—	200	
2164	120	—	
2210	—	150	1985
2273	—	200	1985
2285	500	3,000	
2345	—	500	1985
2351	—	150 per year	1986-91
2375	200	—	
2378	—	120 per year	1985-89
2385	300	—	
2408	—	120	1985
TOTAL:	1,120		
INACTIVE			
2052	200	—	
2040	50	—	
2137	80	80 per year	1984 on
2192	—	410	
2218	250	250	
TOTAL:	480		

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

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NUEXCO

CURRENT MARKET DATA

SWU DEMAND
(As of 10/31/83)

Nuexco Project Number	Delivery Period[1] (Thousands of SWUs) Spot or Near-term[2]	Intermediate or Long-term	Remarks
Inquiries to Purchase:			
ACTIVE			
2233	250	—	
2272	—	200	
2280	—	100	1985
2282	—	300	
2310	200	760	
2355	—	180 per year	1986,88,90,92
2356	5	—	
2362	150	—	
2377	—	80	1987
2400	—	85	1985
2412	—	80	1985
TOTAL:	605		
INACTIVE			
2142	—	35	1985
2237	—	150 per year	1985 on
2339	—	50	1989
2418	—	100	1987

[1]Measured from the date of this Report.
[2]For delivery within one year. This category excludes material deliverable within one year under other than spot or near-term contracts.

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AUSTRALIA

The Cabinet of Australia's Labor government recently made four recommendations to the Labor Party (ALP) caucus which are expected to receive the caucus' approval.

1. The Roxby Downs project in South Australia should be allowed to proceed.

2. Ranger and Nabarlek, the country's only operating projects, should continue to produce and Ranger's two additional proposed contracts with US utilities should be approved.

3. No new export contracts should be allowed and no uranium projects other than Roxby Downs should be activated until a public inquiry into nuclear safeguards, waste disposal and non-proliferation is concluded.

4. A permanent commission should be established to advise the government on uranium policy, to investigate issues relating to the nuclear fuel cycle, and to monitor Australia's position in the nuclear fuel market.

* * *

Recently, the Minister for Environment recommended to the Cabinet that the federal government expand the Kakadu National Park in the Northern Territory to include 6,000 square kilometers, in accordance with promises the ALP made upon gaining office last year. Such an action would lead to the revocation of hundreds of exploration licenses and the planned Jabiluka project, which falls within the proposed boundaries of the park, could not proceed. Previously the minister had recommended that the controversial region be declared a conservation area rather than a national park in order to allow for mining and exploration. Environmentalists have lobbied hard to eliminate mining from the region altogether. However, the new proposal is likely to be opposed by several members of the Cabinet, including the Minister for Resources and Energy and the Minister for Trade.

* * *

Queensland Mines Ltd. is converting the leaching process at its Nabarlek uranium mill in the Northern Territory from pyrolusite to Caro's acid. Extensive plant trials at Nabarlek confirmed that significant savings in acid and lime usage can be achieved by using Caro's acid (permonosulfuric acid), without affecting uranium extraction.

JAPAN

In October the Ministry of International Trade and Industry (MITI) released its most current figures for construction and generation costs for the five main electric power plant types. The figures are summarized in Table 3.

Table 3

COMPARISON OF CONSTRUCTION AND POWER GENERATION COSTS FOR ALTERNATE ELECTRICITY SOURCES: JAPAN

Plant type	Construction Cost (thousands of yen per kilowatt of plant capacity)	Generation Cost (yen per kilowatt-hour of electricity)
Hydroelectric	610	20
Oil	130	17
Coal	230	14
LNG	180	17
Nuclear	300	12.5

The generation cost for nuclear power increased 0.5 yen per kilowatt-hour compared to 1982, while fossil fuel costs declined 1-3 yen per kilowatt-hour, primarily because of conditions in the oil market. Nuclear power still has a clear long-term advantage over alternative electricity sources. For nuclear power to maintain its advantage, MITI emphasized the importance of reducing capital costs.

* * *

On October 18, thirteen years after a construction permit was issued, Tohuku Electric Power Company's Onagawa Unit 1 achieved criticality. Construction time for the 524 MWe BWR was approximately twice as long as for most reactors in Japan, which has a record of efficiency in plant construction. Delays were attributed in part to drawn-out compensation negotiations with a fishermen's association. Onagawa 1 is slated for commercial operation in June 1984.

SOUTH AFRICA

Uranium production in South Africa from gold-uranium operations for the third quarter of 1983 and the year-to-date is itemized in Table 4.

The table includes all of South Africa's uranium producers except for Palabora Mining Company (PMC), which is not a member of the Chamber of Mines. Total third quarter production of approximately 3.9 million pounds U_3O_8 was almost identical to the previous quarter's output. On the up side, BEISA's St. Helena operation produced 34 thousand pounds more than in the second quarter and JMS produced 27 thousand pounds more. Declines in production were noted by Vaal Reefs, down 41 thousand pounds, and Harmony, down 28 thousand.

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RECENT DEVELOPMENTS

Table 4

REPUBLIC OF SOUTH AFRICA: URANIUM PRODUCTION FROM GOLD-URANIUM OPERATIONS
(Thousands of Pounds U_3O_8)

Operation	Third Quarter 1983	Year to Date
Blyvooruitzicht	180	514
Buffelsfontein	337	983
Chemwes	320	885
Dreifontein Consolidated	85	281
ERGO	124	351
Harmony	335	1,064
Hartebeesfontein	252	727
JMS	411	1,166
Randfontein	270	802
St. Helena (BEISA)	267	698
Vaal Reefs	1,042	3,143
Western Areas	170	460
Western Deep Levels	107	295
TOTAL	3,900	11,369

UNITED STATES

During October Nuexco resurveyed US uranium producers with facilities operating in 1983 to ascertain expected production for the year. The results indicate that US U_3O_8 production in 1983 will be approximately 19.7 million pounds. Nuexco's Free World production forecast shown last month in Report 182 (October 1983) had estimated 1983 US production at 16.3 million pounds.

The new amount is higher than previously anticipated for several reasons.

1. Some producers continued to mill ore stockpiled at mines shut down in 1982.
2. Milling capacity increased as some conventional mills previously shut down were reopened.
3. Some mills increased mill throughput and processed higher-grade ore during 1983 than in 1982.
4. One phosphate by-product producer swapped phosphate rock for rock with higher uranium content.
5. The phosphoric acid business is doing better than predicted so uranium by-product production has increased.

Despite the upward revision of the 1983 production estimate, Nuexco expects that 1984 will be a milestone year for several US uranium producers. Inventory build-up can be an indication that a production facility will be closing and that stockpiled yellowcake will be used to supply customers. Known and expected supply commitments would require some mills to operate at less than 50 percent of capacity in 1984. Those mills are likely to be shut down rather than run at a significant loss. US producers indicate that it is too early to estimate 1984 output, but Nuexco's present forecast is approximately 15 million pounds.

CORRECTIONS

Report 182 for October 1983 contained four particularly noticeable errors.

1. The second sentence of the *Executive Summary* reads, "Two uranium sales transactions are reported, involving approximately 260 million pounds U_3O_8 *equivalent.*" The amount indicated should be 260 thousand pounds.
2. On page 16 in the Recent Developments section, the third sentence of the Japan article should read, "On July 26, 1983 a new record of 94,772 MWe was established, which in turn was broken by a total of 99,337 MWe on August 5."
3. On page 20, in the article entitled *Summary of DOE SWU Contracts,* there is an error in Table 6, which details termination charges for Requirements contracts. The table indicates that 3.5-year contract holders that terminate 2-3 years before delivery must pay a 20 percent termination charge, and that 3.5-year holders that terminate 3-3.5 years before must pay a 15 percent charge. In actuality, termination 2-3 years before delivery results in a charge of 15 percent, while termination 3-3.5 years ahead of schedule results in a charge of 10 percent.
4. In the photograph on page 35 representing Figure 6 of the Raw Materials article, the number 2, which should represent the crushing circuit, is barely visible near the right bottom corner of the figure. The crushing circuit is the tall complex at the far right of the photograph. The pressure leach circuit is the system located directly above the number 3 in the figure.

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ESSAY

SHIFTING PATTERNS OF URANIUM SUPPLY AND DEMAND

The nuclear fuel market over the last fifteen years has exhibited three distinct patterns.

1. Producers sell to users in the *primary market.*
2. Some producers buy back from users in the *secondary market for natural uranium.*
3. Users sell to users through *secondary markets for conversion and enrichment services.*

The most interesting aspect of these three patterns, and the most important to understand, is the shifts of emphasis over time from one pattern to the next. While primary market sales of uranium concentrates dominated the early years of the nuclear fuel market, the focus has shifted to the secondary markets. The shifts from one pattern to the next have had strong effects on spot and near-term price movements.

Pattern #1: Primary Market Sales

From the inception of the uranium industry through the late 1970s, users purchased essentially all of their nuclear fuel needs from producers in the primary markets. Little activity took place in secondary markets. Users generally held in inventory any excess purchased material; conversion and enrichment contracts seldom were transferred from one user account to another. During that period, marketing and procurement activities required little sophistication or creativity. The main objective of buyers was to determine future requirements and procure fuel at fixed prices or through relatively low-risk pricing formulas. The main objective of sellers was to conclude long-term sales for large portions of their production capacity.

The rise of oil prices in the early 1970s caused security of fuel supplies to become a primary concern of utility management. Long-term purchasing activity increased and prices rose sharply. At the time it seemed prudent to secure fuel supplies at virtually any price. By April 1976, spot prices for uranium concentrates had reached the $40 per pound level.

Primarily motivated by high nuclear electricity demand forecasts and uncertainty about the extent of uranium reserves, users signed contracts for large quantities of uranium and conversion and enrichment services. Resource limitations and demand forecasts both turned out to be overstated. Between 1976 and 1980, reactor cancellations and delays contributed to the massive build-up of user inventories, while discoveries of extensive high-grade uranium deposits dispelled uncertainties about resources.

Pattern #2: Secondary Market Sales of Uranium Concentrates

The pattern of simple producer-to-user transactions began to give way in 1980 to the opposite pattern. Holders of large uranium surpluses, both producers and users, sold to producers at low prices, setting in motion a rapid price decline. Utilities faced such extreme surpluses that they could sell to producers even after filling inflexible conversion and enrichment contracts. Pressure to liquidate inventories came from cash considerations, high interest rates, intervenors, auditors and regulators.

Buying back yellowcake at falling prices enabled producers with contracts having base prices on the order of $40 per pound to cover operating costs and continue to fulfill their contract obligations at a profit. For producers with excessively high operating costs, who could only survive in a high priced market, it became economical to shut down operations and fill contracts with uranium bought in the secondary market. High-cost producers holding contracts referenced to market prices suffered losses, and production rates fell rapidly in low-grade areas after 1980.

In July 1982 approximately 90 percent of the active spot and near-term supply of uranium was being offered by users, while 70 percent of the active demand was from producers. The shift in the market resulted from creative and innovative thinking on the part of market participants. For utility management, price replaced security of supply as the most important consideration. Utilities that had previously signed contracts having base-escalated pricing mechanisms sought market-related prices in their new contracts. Public utility commissions put pressure on utilities not to pay more than spot prices at the time of delivery. Utilities exhibited a willingness to purchase material produced outside the USA, and the market took on a more international quality. While uranium remained the main focus of attention, means of liquidating conversion and enrichment commitments began to attract significant interest. As much as six years' forward consumption still remained in user inventories, much of it in the form of natural and enriched UF_6.

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ESSAY

Pattern #3: Secondary Market Sales of Conversion and Enrichment

Utilities holding contracts for excessive conversion and enrichment services or owning large blocks of natural or enriched UF_6 had come to realize that they could reduce their borrowing at prevailing high interest rates by selling commitments and inventories in the secondary markets. Users began to sell to other users who, by making adjustments to their contracts with primary sellers of fuel cycle services, found ways to make such transactions economically beneficial.

Conversion services can be purchased in the secondary market at less than half their cost in the primary market. Enrichment services can be purchased in the secondary market for substantially less than the prices charged by Eurodif and DOE, the dominant primary market suppliers.

The primary market suppliers of enrichment services cannot compete with secondary market prices without accepting substantial revenue losses, because of the high real costs of enrichment services. The main primary enricher, DOE, also is obligated by law to price its services to achieve full cost recovery. Recently DOE has lowered the cost of primary market enrichment services for holders of Requirements contracts having 3.5-year fee termination provisions in order to stifle the secondary market, and especially to eliminate the sale of Eurodif SWUs in the US. DOE is also considering the granting of price concessions to holders of Requirements contracts having 5-year fee termination provisions.

Conclusion

Today the nuclear fuel market is characterized by a mixture of all three patterns. Producers are selling to users. Some producers are purchasing uranium from inventory holders, although the level of activity of that pattern is much reduced from its highpoint in 1982. The main emphasis today is on the secondary enrichment market, and to a lesser degree the secondary conversion market. Unfettered, secondary markets provide relief to users holding costly excesses and restore equilibrium to free market systems. In the nuclear fuel market, as user inventories come back into balance, emphasis could shift once again to primary markets (pattern #1). However, if secondary market activities (pattern #3) are stifled, the return to a nuclear fuel market emphasizing primary sales could be delayed for years.

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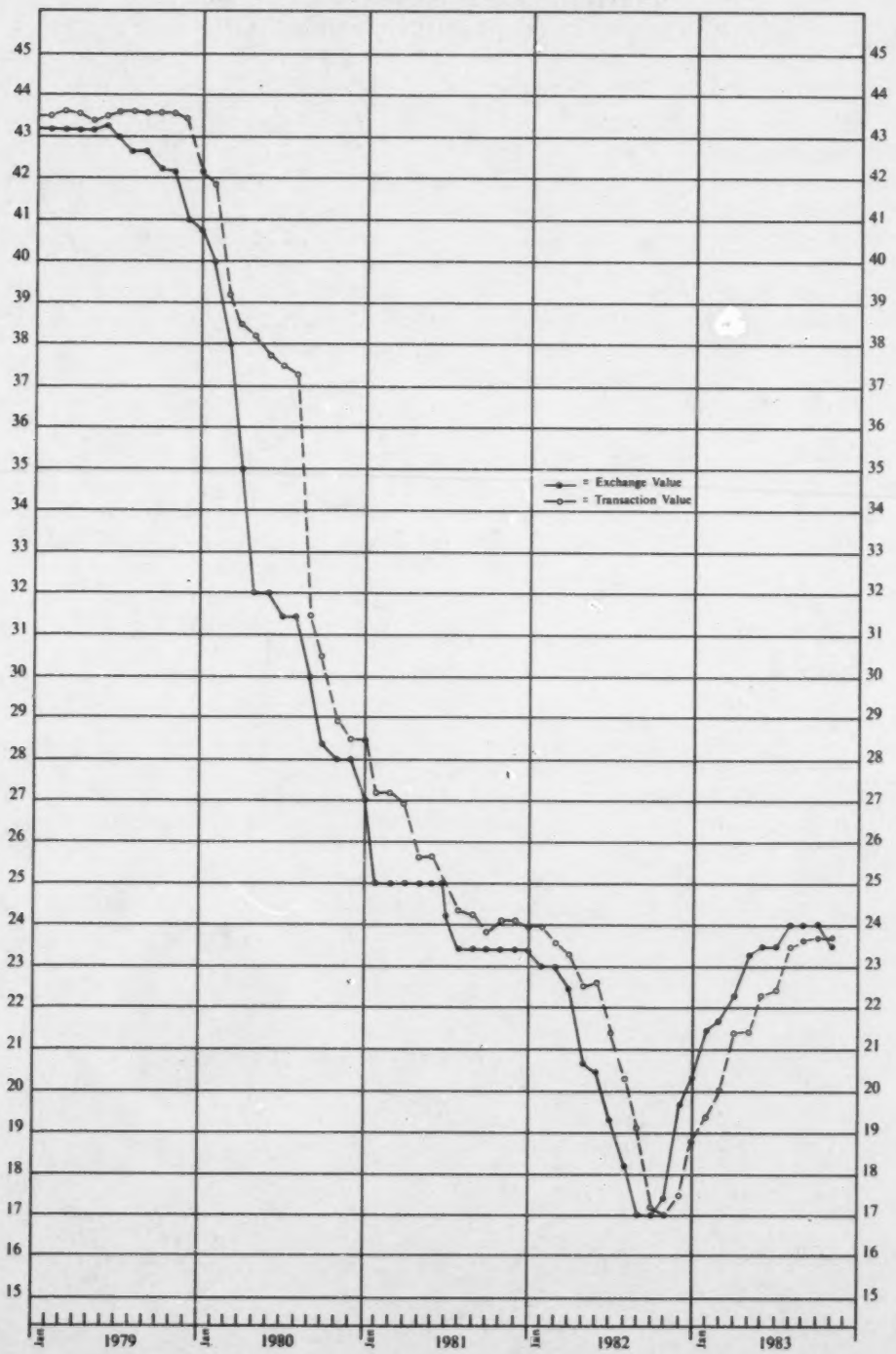
HISTORICAL MARKET DATA

EXCHANGE AND TRANSACTION VALUES SINCE JANUARY 1979

Determined as of the last day of the month indicated



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HISTORICAL MARKET DATA

HISTORICAL EXCHANGE VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1968	—	—	—	—	—	—	—	6.35	6.35	6.40	6.45	6.50
1969	—	6.35	6.10	6.10	6.25	6.25	6.20	6.20	6.15	6.15	6.15	6.20
1970	6.30	6.30	6.30	6.30	6.30	6.30	6.30	6.20	6.15	6.15	6.15	6.15
1971	6.20	6.20	6.20	6.20	6.15	6.05	6.00	5.95	5.95	5.95	5.95	5.95
1972	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95
1973	5.95	6.00	6.10	6.20	6.45	6.50	6.50	6.50	6.50	6.50	6.75	7.00
1974	7.70	7.90	8.00	9.00	9.50	10.50	11.50	12.00	12.50	14.00	14.75	15.00
1975	16.00	16.00	18.00	20.00	21.00	23.00	24.70	26.00	26.00	28.50	30.00	35.00
1976	35.20	37.00	39.25	40.00	40.00	40.00	40.00	40.40	41.00	41.00	41.50	41.00
1977	41.35	41.50	41.60	41.60	42.00	42.25	42.25	42.25	42.40	42.75	43.20	43.20
1978	42.90	43.25	43.25	43.25	43.40	43.40	43.40	43.10	43.25	43.00	43.25	43.25
1979	43.25	43.25	43.25	43.25	43.25	43.00	42.70	42.70	42.20	42.20	41.00	40.75
1980	40.00	38.00	35.00	32.00	32.00	31.50	31.50	30.00	28.50	28.00	28.00	27.00
1981	25.00	25.00	25.00	25.00	25.00	24.25	23.50	23.50	23.50	23.50	23.50	23.50
1982	23.00	23.00	22.50	20.75	20.50	19.25	18.25	17.00	17.00	17.50	19.75	20.25
1983	21.50	21.75	22.25	23.25	23.50	23.50	24.00	24.00	24.00	**23.50**		

HISTORICAL TRANSACTION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_3O_8)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1976	—	—	—	—	39.60	39.70	39.70	40.40	40.30	40.60	40.70	40.70
1977	41.30	41.30	41.40	41.50	42.80	42.90	43.00	42.60	42.50	42.80	42.90	42.90
1978	43.10	43.30	43.70	43.60	43.60	43.20	43.30	43.40	43.40	43.60	43.40	43.70
1979	43.60	43.80	43.70	43.40	43.60	43.70	43.70	43.60	43.60	43.60	43.50	42.30
1980	42.00	39.30	38.60	38.40	37.90	37.60	37.30	31.60	30.60	29.00	28.70	27.70
1981	27.20	27.20	27.00	25.70	25.70	24.50	24.40	24.30	23.90	24.10	24.10	24.00
1982	24.00	23.70	23.40	22.60	22.70	21.50	20.30	19.10	17.30	17.00	17.55	18.80
1983	19.35	20.00	21.35	21.40	22.35	22.45	23.50	23.60	23.65	**23.65**		

HISTORICAL CONVERSION VALUES

Determined as of the last day of the month indicated (US Dollars/lb. U_6)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1981	1.20	1.20	1.20	1.40	1.15	1.15	1.15	1.10	1.10	1.10	1.20	1.20
1982	1.20	1.20	1.20	1.20	1.00	1.00	1.00	0.90	1.10	1.60	1.45	1.45
1983	1.20	1.40	1.40	1.20	1.20	1.20	1.10	1.10	1.00	**0.60**		

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HISTORICAL MARKET DATA

AUSTRALIA

	Price Index of Materials Used in Manufacturing Industry—All Groups (Year 1968-69 = 100.0)[1]	Award Rates of Pay Indexes Australia—Adult Males In Mining Wage Earners, Weekly Rates (Year 1976 = 100.0)[2]
Annual Avg. 1972[3]	105.6	71.26
Annual Avg. 1973[3]	124.4	78.96
Annual Avg. 1974[3]	141.9	108.07
Annual Avg. 1975[3]	150.4	132.55
Annual Avg. 1976[3]	168.4	160.93
Annual Avg. 1977[3]	192.0	179.03
Annual Avg. 1978[3]	198.5	190.04
Annual Avg. 1979	248.8	196.34
Annual Avg. 1980	321.8	218.00
Annual Avg. 1981	355.3	237.34
Annual Avg. 1982	368.5	174.88
Jun 1982	367.8	173.2
Jul 1982	370.0	177.2
Aug 1982	372.5	178.2
Sep 1982	375.2	178.4
Oct 1982	378.4	178.4
Nov 1982	375.8	178.5
Dec 1982	374.8R	179.5
Jan 1983	385.6R	179.6
Feb 1983	387.4R	179.5
Mar 1983	397.3R	179.4
Apr 1983	407.4R	179.7
May 1983	414.9P	179.8
Jun 1983	415.8P	179.9
Jul 1983	—	179.5
Aug 1983	—	179.5P

P = Preliminary R = Revised since last month

[1]Australian Bureau of Statistics, Canberra: "Price Index of Materials Used in Manufacturing Industry" (Catalogue No. 6411.0), Table 3.
[2]Australian Bureau of Statistics, Canberra: "Award Rates of Pay Indexes, Australia" (Catalogue No. 6312.0), Table 8. Figures for the latest fourteen months shown are subject to revision.
[3]Monthly data for 1970 through 1978 appear on pages 4.7 and 4.8 of Nuexco Report 138.

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GOVERNMENT STATISTICS

CANADA

	Industry Selling Price Index: Manufacturing (D 500000)[1] [2] (1971 = 100.0)	Wage-earner Data: Average Hourly Earnings (C$)[4] [5] [6]				
		Metal Mining, including Milling (SIC 050-099)[3]	Primary Metal Industries, non-ferrous (SIC 296-298)[7]			Chemicals and Chemical Products (SIC 372-379)[8]
			(SIC 296)		(SIC 298)	
Annual Avg. 1979	217.9	9.66	—	7.35	—	7.67
Annual Avg. 1980	247.2	10.80	—	8.05	—	8.50
Annual Avg. 1981	288.7	12.23	—	9.03	—	9.53
Annual Avg. 1982	288.8	13.92	—	9.98	—	10.63
Jul 1982	290.3	14.02	—	10.05	—	10.73
Aug 1982	290.3	14.23	—	10.03	—	10.80
Sep 1982	292.4	14.01	—	10.18	—	10.73
Oct 1982	292.1	13.89	—	10.18	—	10.86
Nov 1982	291.3	14.28	—	10.43	—	10.90
Dec 1982	292.3	14.32	—	10.55	—	11.06
Jan 1983	292.7	14.35	—	10.72	—	11.06
Feb 1983	293.5	14.28	—	10.74	—	11.06
Mar 1983	295.2	14.48	—	10.93	—	11.21
Apr 1983	297.1	14.13	11.57	—	10.10	11.02
May 1983	298.5	14.10	11.39	—	9.82	10.97
Jun 1983	299.2	14.07	11.33	—	9.84	11.05
Jul 1983	300.3R	13.93R	11.70R	—	9.83R	11.04
Aug 1983	301.0R	13.71P	11.84P	—	10.08P	11.17P
Sep 1983	300.6P	—	—	—	—	—

P = Preliminary R = Revised since last month

[1]Statistics Canada, Prices Division, Ottawa: "Industry Price Indexes" (Catalogue 62-011), Table 1. Indexes for the most recent six months shown are subject to revision.

[2]Monthly data for 1973 through 1978 appear on page 4.10 of Nuexco Report 138.

[3]The wage earner series in Nuexco reports prior to March 1983 was Metals (SIC 050-059).

[4]Statistics Canada, Labour Division, Employment and Payrolls Section, Ottawa: "Employment, Earnings and Hours" (Catalogue 72-002), Table 2.

[5]Monthly data for 1977 and 1978 appear on page 4.11 of Nuexco Report 138.

[6]Beginning with the April 1983 figure, Wage Earner Data are based on a census of all companies employing 200 or more wage earners, *plus* a random survey of companies employing fewer than 200 wage earners. Prior to April 1983 only companies employing 200 or more wage earners are included in the Wage Earner Data.

[7]Beginning with the April 1983 figure, Primary Metal Industries, non-ferrous is split into SIC 296 and SIC 298.

[8]Chemical and Chemical Products prior to April 1983 was SIC 370-379. The new series is from a new survey which includes all companies and is based on a 1970 classification. The old survey included companies of 20 employees or more.

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GOVERNMENT STATISTICS

REPUBLIC OF SOUTH AFRICA

	Average Declared Working Costs per Metric Ton of Gold Ore Milled (Rand)[1]	Consumer Price Index[2] (1975 = 100, except where otherwise indicated)	Producer[4] Price Index All Groups (1975 = 100)	Total Employment in Mining and Quarrying (Code 35)[7]	Total Salaries and Wages in Mining and Quarrying (1,000 Rand) (Code 40)[7]
Annual Avg. 1972[3]	8.79	113.3[4]	63.9	623,067	443,933
Annual Avg. 1973[3]	10.51	124.1[4]	72.3	684,743	572,133
Annual Avg. 1974[3]	13.18	138.5[4]	85.3	674,140	761,596
Annual Avg. 1975[3]	16.71	157.2[4]	100.0	639,473	1,003,617
Annual Avg. 1976[3]	19.30	174.7[4]	115.1	671,240	1,212,983
Annual Avg. 1977[3,6]	23.87	194.4[4]	130.0	712,006	1,420,670
Annual Avg. 1978[3,6]	27.14	137.2	142.7	664,571	1,537,169
Annual Avg. 1979[3,6]	30.18	155.3	164.5	692,209	1,830,632
Annual Avg. 1980[6]	35.53	176.7	192.1	714,379	2,279,615
Annual Avg. 1981	41.89	206.5	218.3	728,506	2,820,505
Annual Avg. 1982	47.25	233.5	248.7	707,552	3,246,071
Apr 1982	—	228.9	241.9	707,502	252,562
May 1982	—	230.3	244.8	715,162	258,770
Jun 1982	45.77	232.1	246.7	707,552	261,361
Jul 1982	—	234.1	249.4	702,141	283,248
Aug 1982	—	236.8	253.4	705,562	276,730
Sep 1982	48.04	241.0	255.0	704,344	282,782
Oct 1982	—	243.9	260.1	701,316	285,328
Nov 1982	—	245.4	262.5	707,966	287,699
Dec 1982	49.62	246.2	263.0	683,982	288,019
Jan 1983	—	249.0	264.9	688,030	289,075
Feb 1983	—	253.1	267.4	697,089	281,413
Mar 1983	50.35	255.9	269.1	695,976	290,586
Apr 1983	—	257.8	270.9	697,158	286,708
May 1983	—	259.7	274.1	701,712	295,701
Jun 1983	50.51	260.8	273.1	706,933	300,177
Jul 1983	—	262.5	273.7	704,202	314,566
Aug 1983	—	265.6	278.9	—	—
Sep 1983	—	267.3	—	—	—

[1]Chamber of Mines of South Africa, Johannesburg; "Analysis of Working Results," published quarterly. The tonnage-weight index of average working costs per metric ton of gold ore milled for 1983 is as follows. (Base: March quarter 1982 = 100). See Nuexco report #178 page 24 for the tonnage-weighted index for 1982. Description and calculation of the index is on page 16 of Nuexco report #178.

1983: January-March 111.2
April-June 111.9

[2]Republic of South Africa Department of Statistics, Pretoria; "Government Gazette: Consumer Price Index for Urban Areas."

[3]Historical data for the Average Declared Working Costs and Consumer Price Index 1970-1979 appear on page 4.9 of Nuexco Report 140.

[4]April 1970 = 100.00.

[5]Previously known as the WHOLESALE PRICE INDEX, now the PRODUCER PRICE INDEX. The computation remains the same.

[6]Historical data for Codes 35 and 40 1977-1980 appear on page 28 of Nuexco Report 157.

[7]Bulletin of Statistics, Department of Statistics, Pretoria.

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GOVERNMENT STATISTICS

UNITED STATES

	Producer Price Index—Industrial Commodities (1967 = 100)[1]	Producer Price Index—All Commodities (1967 = 100)[1]	Consumer Price Index (1967 = 100)[2]	GNP Implicit Price Deflator (1972 = 100)[3]	Gross Average Hourly Earnings of Production or Non-supervisory Workers (US$)[4]			
					Metal Mining (SIC 10)	Primary Non-ferrous Metals (SIC 333)	Chemicals and Allied Products (SIC 28)	Electric and Electronic Equipment (SIC 36)
Annual Avg. 1972[5]	117.9	119.1	125.3	100.00	4.56	4.59	4.26	3.71
Annual Avg. 1973[5]	125.9	134.7	133.1	105.75	4.84	4.98	4.51	3.91
Annual Avg. 1974[5]	153.8	160.1	147.7	115.08	5.44	5.63	4.88	4.21
Annual Avg. 1975[5]	171.5	174.9	161.2	125.79	6.13	6.24	5.39	4.64
Annual Avg. 1976[5]	182.4	183.0	170.5	132.34	6.76	6.87	5.91	4.96
Annual Avg. 1977[5]	195.1	194.2	181.5	140.05	7.28	7.67	6.43	5.39
Annual Avg. 1978[5]	209.4	209.3	195.4	150.42	8.23	8.56	7.02	5.82
Annual Avg. 1979[5]	236.5	235.6	217.4	163.42	9.27	9.50	7.60	6.32
Annual Avg. 1980[5]	274.8	268.8	246.8	178.64	10.26	10.63	8.30	6.94
Annual Avg. 1981	304.1	293.4	272.4	195.51	11.55	11.98	9.12	7.62
Annual Avg. 1982	312.3	299.3	289.1	207.15	12.33	12.94	9.96	8.21
Sep 1982	312.7	299.3	293.3	208.51	12.53	13.51	10.19	8.37
Oct 1982	314.3	299.8	294.1	—	12.51	13.26	10.22	8.41
Nov 1982	315.0	300.3	293.6	—	12.53	13.22	10.26	8.45
Dec 1982	315.2	300.7	292.4	210.00	12.53	13.05	10.32	8.51
Jan 1983	313.9	299.9	293.1	—	12.63	13.33	10.34	8.53
Feb 1983	313.9	300.9	293.2	—	12.66	13.29	10.41	8.56
Mar 1983	313.5	300.6	293.4	212.83	12.48	13.35	10.39	8.60
Apr 1983	312.4	300.6	295.5	—	12.67	13.34	10.43	8.60
May 1983	313.6R	301.5R	297.1	—	12.55	13.62	10.50	8.60
Jun 1983	315.4	302.5	298.1	214.55	12.66	13.38	10.52	8.63
Jul 1983	316.6	303.2	299.3	—	12.68R	13.56R	10.58R	8.69R
Aug 1983	317.5	304.9	300.3	—	12.63P	13.48P	10.60R	8.64R
Sep 1983	317.2P	305.3P	301.8P	216.37P	—	—	10.73P	8.77P

P = Preliminary R = Revised since last month

[1]US Bureau of Labor Statistics, Washington, D.C.; "Producer Prices and Price Indexes," Table 6 (formerly "Wholesale Prices and Price Indexes"). Producer Price Indexes are revised four months after they are first released to reflect the availability of late reports and corrections by respondents.
[2]US Bureau of Labor Statistics, Washington, D.C.; Consumer Price Index for All Urban Consumers, US City Average, All Items.
[3]US Department of Commerce, Washington, D.C.; Bureau of Economic Analysis, National Income and Wealth Division; "Survey of Current Business," Table 7.1. The GNP Implicit Price Deflator is published quarterly, and seasonally adjusted.
[4]US Bureau of Labor Statistics, Washington, D.C.; "Employment and Earnings," Table C-2. All data based on 1972 revision of SIC Manual. Data for 1970-1976 are adjusted to the March 1977 benchmark. Data for 1977-1978 are adjusted to the March 1979 benchmark. Data for January 1979 and beyond are adjusted to the March 1980 benchmark.
[5]Monthly data 1970-1978 for Producer Price Index-Industrial Commodities, Consumer Price Index, and Employment and Earnings SIC codes 10, 333, and 28, and quarterly data for GNP Implicit Price Deflator appear on pages 4.6-4.8 of Nuexco Report 139.
Monthly data 1977-1978 for Employment and Earnings SIC Codes 10, 333, and 28 appear on page 33 of Nuexco Report 147.
Monthly data 1970-1978 for Employment and Earnings SIC Code 36 appear on page 23 of Nuexco Report 154.
Monthly data 1979-1980 for Employment and Earnings, Revised Establishment Data, all listed codes, appear on page 22 of Nuexco Report 158.
Monthly data 1977-1980 for Producer Price Index-All Commodities, appear on page 21 of Nuexco Report 158.

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